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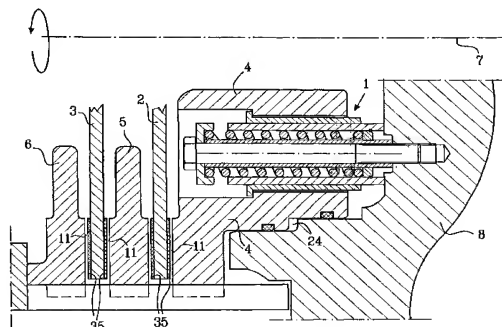
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(54) Title: DEVICE FOR DISPLACING AN OBJECT A CERTAIN DISTANCE



(57) **Abstract:** A device for displacement of an object (4) a certain distance which object is displaceable between a forward position (9) and a rearward position (10), comprising a unit (14) displaceable between a first position (12) and a second position (13) for driving the object a distance corresponding to the distance between the first and the second position by means of a friction joint (15) when the driving unit (14) is displaced from the first position to the second position. The friction joint is designed to enable displacement of the driving unit (14) and the object (4) relative to each other under the influence of a certain lowest force. Furthermore, the device comprises a member (16) which is arranged to act on the driving unit (14) in a direction towards the second position (13) by means of a spring force and a component (21) for interconnecting the driving unit (14) and the object (4). The interconnecting component (21) has a surface (22) which is designed to form the friction joint (15) in cooperation with a surface (23) of the driving unit, and the interconnecting component and the object are interconnected so that the interconnecting component and the object are locked against displacement relative to each other when the object (4) is acted on in a direction towards the forward position (9) and the interconnecting component (21) is acted on in the opposite direction, for driving the object (4) to the rearward position (10) by means of interconnecting component (21) when the driving unit (14) is displaced to the second position (13) during influence of the spring member and for driving unit (14) to the first position (12) by means of the interconnecting component (21) when the object (4) is displaced to the forward position (9).



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## 5 A DEVICE FOR DISPLACING AN OBJECT A CERTAIN DISTANCE

## FIELD OF THE INVENTION AND PRIOR ART

10 The present invention relates to a device for displacement of an object a certain distance which object is displaceable between a forward position and a rearward position, comprising a unit displaceable between a first position and a second position for driving the object a distance corresponding to the distance between the first and the second position by means of a friction joint when the driving unit is displaced from the first position to the second position, the friction joint being designed to enable displacement of the driving unit and the object  
15 relative to each another under the influence of a certain lowest force, and a member which is arranged to act on the driving unit in a direction towards the second position by means of a spring force.

20 The invention may be used for displacing different object in many technical applications, but hereinafter the particular, but not in any way limiting for the invention, fields of application, constituting a means for automatic adjustment of the play between a brake piston and a brake disc cooperating with the brake piston will be described. In this field of application, when the brake piston is displaced from the brake disc after a brake operation has been accomplished it is desired that the piston be displaced a distance of equal length each time,  
25 independent of the wear of the brake lining occurring on the brake disc. The reason why this repeatability is desired is that hereby one and the same distance between the piston and the brake disc is obtained for every brake operation, and thereby one and the same quantity of hydraulic oil for displacing the piston so that it will be in contact with the brake disc is needed in every brake operation, independent of the wear of the brake lining.

30 Such a device for adjustment of play in a friction brake is described for example in US Patent No. 6 131 705. Although the device described in said patent works very well in many respects, under certain circumstances it has been shown to have drawbacks. When the device is under load, and in particular such a load which give rise to radial fluctuations such as  
35 vibrations of the piston, i.e. fluctuations in a direction which is substantially perpendicular to the displacement direction of the piston, it has been shown that the friction joint included in the device between the piston and a spring loaded sleeve arranged in the piston, which friction joint has the task of transferring the requisite displacement force from a spring to the brake piston when the brake piston is returned and which friction joint in the braking  
40 operation has to ensure that the piston may be displaced relative to the sleeve if needed to reach the brake disc, does not work very well which means that the displacements of the piston cannot be accomplished as intended.

## 5 THE OBJECT OF THE INVENTION AND SUMMARY OF THE INVENTION

One object of the invention is to provide a device of the kind defined by way of introduction, in which device the problem with the friction joint discussed above in such previously known devices has been reduced to a great extent, i.e. a device which is able to provide the desired  
10 displacement of the object, such as a brake piston, to a greater extent even when the object is under load so that fluctuations of the object arise in a direction which is substantially perpendicular to the intended displacement direction of the object.

This object is achieved by a device which comprises a component for interconnecting the  
15 driving unit and the object and in which device the interconnecting component has a surface which is designed to form the friction joint in cooperation with a surface of the driving unit, and the interconnecting component and the object are interconnected so that the interconnecting component and the object are locked against displacement relative to each other when the object is acted upon in a direction towards the forward position and the  
20 interconnecting component is acted upon in the opposite direction, for driving the object to the rearward position by means of the interconnecting component when the driving unit is displaced to the second position during influence of the spring member and for driving the driving unit to the first position by means of the interconnecting component when the object is displaced to the forward position.

25 By the use of the interconnecting component such that the object does not constitute part in the friction joint, the device becomes less sensitive to motions, vibrations and deformations of the object, which arise as a consequence of the object having been loaded in a direction which is substantially perpendicular to the intended displacement direction of the object. In addition,  
30 the object does not need to have such a high degree of dimensional accuracy, since it could be allowed, and in some cases it could be an advantage, that a play occurs between the object and the interconnecting component in a direction which is substantially perpendicular to the intended displacement direction of the object.

35 According to one preferred embodiment of the invention the interconnecting component and the object are arranged relative to each other so that a play having an extension in a direction which is substantially perpendicular to the displacement direction of the object between the forward and the rearward positions occurs between the interconnecting component and the object. By arranging such a play it could be avoided to a greater extent that the object  
40 through the interconnecting component transfers an undesired force to the friction joint even if a delimiting surface of the object, by for example vibrations, is displaced in an undesired direction towards the interconnecting component and the friction joint.

5 According to another preferred embodiment of the invention the interconnecting component is provided with a shoulder and the object is provided with a corresponding shoulder, and these shoulders are arranged to co-operate for the interconnection of the interconnecting component and the object. Thanks to the shoulders, which lock the interconnecting component and the object against displacement relative to each other in the current mutual  
10 displacement direction when lying in abutment with each other, an easy and reliable construction for interconnecting the interconnecting component and the object is obtained so that when the driving unit is displaced, and thereby the interconnecting component, the interconnecting component pushes the object in a direction towards the rearward position and when the object is displaced, the object pushes the interconnecting component, and thereby  
15 the driving unit, in a direction towards the first position. Furthermore, the possibility to arrange the interconnecting component and the object so that these overlap each other when seen in a direction which is substantially perpendicular to the intended displacement direction of the object is obtained. Such an overlap has in turn a potential to contribute to a construction which takes up less space.

20 Further advantages and advantageous features of the device according to the invention will become apparent from the following description and the attached dependent claims.

The invention relates also to an arrangement to brake a vehicle, a vehicle comprising a device  
25 according to the invention, and to the use of a device according to the invention for automatical adjustment of a brake piston and a brake disc cooperating with the brake piston at a certain distance relative to each other.

#### BRIEF DESCRIPTION OF THE DRAWINGS

30 A description in greater detail of exemplifying embodiments of the invention will follow below with reference to the attached drawings.

In the drawings:

35 Fig. 1 is a sectional view of a brake arrangement including a device according to the invention,

Fig. 2 is an enlarged view of the device according to the invention in figure 1,

40 Fig. 3 is a schematic picture illustrating the function of the device according to the invention in a brake arrangement, the brake arrangement being in a rest position, and

- 5 Fig. 4 is a schematic picture illustrating the function of the device according to the invention in the brake arrangement, the brake arrangement being in a brake position.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

- 10 In figure 1 a brake arrangement including a device 1 according to the invention is illustrated in a sectional view. The brake arrangement includes two brake discs 2, 3, one 2 of them being arranged to cooperate directly with a piston 4. The brake discs 2, 3 are provided with linings 35 to increase the friction between the discs on the one hand and the piston, a stator disc 5 and a counter disc 6 on the other hand. Furthermore, the brake discs 2, 3 are mounted on an  
15 axis 7, such as for example a wheel axle of a vehicle. The piston 4 is slidably journaled in a housing 8 for linear displacement between a forward position during braking and a rearward position when a play 11 occurs between the piston 4 and the brake disc 2 located closest thereto.
- 20 Figure 2 shows a device according to the invention in an enlarged view and in Figs. 3 and 4 it is illustrated in more detail how the device according to the invention works. The device comprises a unit 14 displaceable between a first position 12 and a second position 13 for driving an object 4 displaceable between a forward position 9 and a rearward position 10, which object is constituted by the piston 4 in the illustrated embodiment, a distance  
25 corresponding to the distance between the first 12 and the second 13 position by means of a friction joint 15 when the driving unit is displaced from the first position 12 to the second position 13. Furthermore, the device comprises a member 16 which is arranged to act on the driving unit 14 in a direction towards the second position 13 by means of a spring force. Suitably, one or more devices according to the invention are arranged in bore holes 17 of the  
30 piston 4 and fastened in the housing 8 by means of for example a pin 18, bolt or similar. The driving unit 14 is preferably a sleeve displaceable along the pin 18 and having for example a circular cross-section arranged substantially concentrically around the pin 18. Externally of the pin 18 and internally of the sleeve 14, the spring member 16, here in the shape of a helical spring, is arranged to act on the sleeve 14 in a direction towards the second position  
35 13 (to the right in the drawing figures 1-4). For enabling the spring 16 to transfer the force to the sleeve 14, the sleeve has internally a counter component 19 against which the spring 16 in one end thereof abuts and in the free end 32 of the pin 18 a corresponding counter component 20 is arranged against which the other end of the spring 16 abuts. Obviously, other types of springs may also be used for this function and within the term "spring member"  
40 any component which has the requisite spring action while creating the current spring force is included.

The device according to the invention further comprises a component 21 for interconnecting the driving unit 14 and the piston 4. The interconnecting component 21 has a surface 22

5 which is designed to form the friction joint 15 in cooperation with a surface 23 of the driving unit 14 and the interconnecting component 21 and the piston 4 are interconnected so that the interconnecting component 21 and the piston 4 are locked against displacement relative to each other when the piston is acted on in a direction towards the forward position 9 and the interconnecting component 21 is acted on in the opposite direction, for driving the piston 4 to  
10 the rearward position 10 by means of the interconnecting component 21 when the driving unit 14 is displaced to the second position 13 under influence of the spring member 16 and for driving the driving unit 14 to the first position 12 by means of the interconnecting component 21 when the piston 4 is displaced to the forward position 9. The interconnecting component 21 is preferably a second sleeve having a cross-section corresponding to the first sleeve and  
15 which second sleeve is arranged concentrically and externally relative to the first sleeve.

Thus, the function of the friction joint 15 is to transfer the force from the spring 16 to the interconnecting component 21, and thereby to the piston 4, when the piston 4 is returned, i.e. after braking of the brake discs 2,3 has been accomplished, and to transfer the force from the  
20 interconnecting component 21 to the driving unit 14 when the piston is displaced in the opposite direction. At the same time as this friction joint 15 has to be designed in a way being capable of transferring the current forces it must also allow the interconnecting component 21, and thereby the piston 4, and the driving unit 14 to be displaced relative to each other in the case that the piston 4 has to be displaced further after the driving unit 14 has reached the  
25 first position 12 so as to enable the piston 4 to reach the forward position 9, which may be the case when the lining of the brake disc has been worn in the preceding braking operation.

The displacement of the piston 4 to the forward position 9 is accomplished by hydraulic oil being supplied to a chamber 24 (see Figs. 1 or 2) between the piston 4 and the housing 8 so  
30 that the piston is acted on by a force in the direction towards the brake disc 2. When decreasing the pressure of the hydraulic oil and draining the chamber 24 the piston 4 will return to the rearward position 10 by means of the spring force. Due to the fact that the driving unit 14 will drive the piston 4 a distance corresponding to the distance which occurs between the first position 12 and the second position 13 of the driving unit, the piston will  
35 always be displaced a distance of equal length from the brake disc 2, and from the forward position 9, to the rearward position 10 independent of how it is located relative to the driving unit 14 in the forward position 9. This is true in spite of any wear of the lining of the brake disc 2. This means that as the wear of the brake lining continues the forward and the rearward positions of the piston 4 will be gradually changed a little, i.e. be displaced in a  
40 direction towards the brake disc 2 (to the left in drawing figures 1-4).

Although the interconnecting component 21 in the illustrated embodiment is provided with a shoulder 25 and the piston 4 is provided with a corresponding shoulder 26, and these shoulders 25, 26 are arranged to cooperate for the interconnection of the interconnecting

5 component 21 and the piston 4, other types of couplings could also be used. The main thing is  
that such a interconnection between the interconnecting component 21 and the piston 4 may  
be achieved so that displacement of the interconnecting component 21 and the piston 4  
relative to each other is impeded when the piston 4 is acted on in a direction towards the  
10 brake disc 2 and the interconnecting component 21 is acted on in an opposite direction and  
that the displacement of the piston may be accomplished without the piston constituting part  
of the friction joint 15. In the simplest case, a surface of the interconnecting component could  
cooperate with a surface of the object so that the interconnecting component and the object  
are located after each other along the intended displacement direction of the object. The use  
15 of a shoulder of the interconnecting component and/or the object often provides, however, a  
space-saving construction since the interconnecting component and the object may be  
arranged to overlap each other. Although the shoulders in the illustrated embodiment are  
designed as ring-shaped flanges of respective sleeves, when using the concept having a  
protruding portion of any kind, one or more discrete such portions may be used and  
20 furthermore these portions may have a number of different shapes. It should be emphasized  
that neither the driving unit nor the interconnecting component necessarily have to be a  
sleeve and even in the case when such a sleeve is used, the sleeve could also be for example  
slotted so that it displays several discrete portions.

In accordance with the invention, and if so is desired, the piston 4 and the interconnecting  
25 component 21 may be designed and positioned so that the interconnecting component 21  
and/or a play 27, which is located between the piston 4 and the interconnecting component  
21 in a direction which is substantially perpendicular to the surfaces 22, 23 included in the  
friction joint 15, may take up any deformations of the piston 4. The requisite friction joint 15  
between the driving unit 14 and the interconnecting component 21 may thereby remain  
30 unaffected by certain smaller fluctuations of the piston 4 which eventually arise in the current  
direction as a consequence of the piston being loaded. By means of the play 27 it is avoided  
that an undesired force is transferred from the object to the interconnecting component and  
further to the friction joint, which otherwise could take place for example should vibrations  
occur in the object which vibrations in turn mean that a limiting surface of the object moves  
35 in a direction alternatively towards and away from the interconnecting component. However,  
instead of the play, or in combination therewith, it is possible to design the interconnecting  
component so that it is provided with at least one portion for taking up any occurring  
deformation of and/or force from the object to thereby avoid the contact surfaces of the  
friction joint from being loaded. For example an outer layer of the interconnecting component,  
40 including the surface turned towards the object, could be relatively soft compared to the layer  
including the surface with constitutes part of the friction joint so as to minimize the effect of  
the object on the friction joint.

5 To obtain well defined end positions of the driving unit 14 corresponding to the first 12 and the second 13 positions, the device comprises a first stop 28 against which first stop 28 the driving unit 14 abuts when being in the first position 12 and when the object 4, here the piston, is in the forward position 9, and furthermore it comprises a second stop 29 against which second stop 29 the driving unit 14 abuts when being in the second position 13 and  
10 when the object 4 is in the rearward position 10. In the embodiment illustrated the driving unit 14 is located substantially between the first stop 28 and the second stop 29 and the extension of the driving unit 14 between a surface 30 of the driving unit 14 which is intended to abut against the first stop 28 and a surface 31 of the driving unit 14 which is intended to abut against the second stop 29 is adapted to the distance between the first stop 28 and the  
15 second stop 29 so that, when the driving unit is in the second position 13 (such as illustrated in Figs. 1-3), the distance 50 between the first stop 28 and the surface 30 of the driving unit 14 which is intended to abut against the first stop 28 corresponds to the distance that the object 4 is displaced from the forward position 9 when being displaced from the forward position 9 to the rearward position 10. Hereby the distance that the piston 4 is displaced in  
20 the direction away from the brake disc 2 may be determined by adapting said extension of the driving unit 14. Thus, the distance 50 corresponds to the total play 11 which occurs between the different components, i.e. the counter disc, the stator disc, the brake discs and the piston in the illustrated embodiment, when the piston is in the rearward position 10. In the illustrated embodiment the pin 18 in the free end 32 thereof is provided with said first  
25 stop 28 and in the second anchored end 33 thereof is provided with said second stop 29.

Although the driving unit 14, the interconnecting component 21 and the object 4 itself in the illustrated embodiment are designed for a substantially rectilinear displacement, it is also possible when applying the invention to displace an object a certain distance by pivoting the  
30 object and in such connection use components which are pivotable relative to each other. In such a case these components are suitably arranged to be pivotable about one and the same pivot axis.

With reference first to Figs. 3 and 4, hereinafter follows a description of the functions of the  
35 device according to the invention when being used together with a brake arrangement. For the purpose of simplifying in the example, it is assumed that the entire current play 11 in the brake corresponds to the distance between the brake disc 2 and the piston 4 when being in a rest position.

40 In Fig. 3 the piston 4 is schematically illustrated in the rearward position 10 thereof and the driving unit 14 in the second position 13 thereof where it abuts against the second stop 29 of the housing 8. Thus, in this rest position of the brake arrangement no braking action takes place and there is a play 11 between the piston 4 and the brake disc 2. This play 11 is substantially as great as the distance 50 between the first stop 28 for the driving unit 14 and



5 the surface 30 of the driving unit 14. From the rest position braking is accomplished by hydraulic oil being supplied to the chamber 24 (see Fig. 1 or 2) whereby the piston 4 is displaced towards the forward position 9, i.e. towards the brake disc 2 (to the left in the Figs. 1-4). Through the interconnection with the piston 4 the interconnecting component 21 will in the same way be displaced in the same direction as the piston 4 when the piston is displaced.

10 Because of the friction joint 15 between the interconnecting component 21 and the driving unit 14, the driving unit 14 will also be displaced. During displacement of the driving unit 14, the spring 16 (not illustrated in Figs. 3 and 4) will be compressed between both the counter components 19, 20 arranged for the spring 16. When the driving unit 14 reaches the first position 12 and thereby abuts against the first stop 28, the driving unit 14 may however not

15 be further displaced in the current direction, which means that by a certain lowest force determined by the design of the friction joint 15, the piston 4 and the interconnecting component 21 will be displaced further as long as this displacement is not impeded by the brake disc 2, while the driving unit 14 remains in the first position 12 and the interconnecting component 21 and the driving unit 14 slide relative to each other. This further displacement

20 of the piston 4 is required so as to bring the piston into contact with the brake disc and to obtain the requisite brake action in the case the lining of the brake disc 2 has become worn. In this state such as illustrated in Fig. 4 the braking of the brake disc 2 is accomplished. In Fig. 4 it is also schematically illustrated how the piston 4 has passed beyond the brake position 60 of the preceding braking operation to some extent.

25 After accomplishing the brake operation, when lowering the hydraulic pressure and draining the chamber 24, the driving unit 14 will be returned to the second position 13, corresponding to the original state illustrated in Fig. 3, by means of the spring force of the spring 16. When displacing the driving unit 14, this will drive the interconnecting component 21 and also the

30 piston 4, since the piston 4 is interconnected with the interconnecting component 21, by means of the friction joint 15, a distance corresponding to the above mentioned distance 50. The device is then in position to again perform a brake operation for which substantially the same amount of hydraulic oil is needed as was the case for the preceding brake operation independent of any wear of the lining of the brake disc 2.

35 It will be obvious that the invention is not restricted to the exemplified embodiments of the invention described herein, but only by the following claims. Even if the invention has been described to be applied in a brake arrangement it is obvious to a man skilled in the art that the invention may be applied within a number of other fields of use as well. For example the

40 invention may advantageously be applied in a clutch arrangement. Once the idea of the invention has been introduced, further modifications within the scope of the invention should be obvious for a man skilled in the art.

5

**CLAIMS**

10 1. A device for displacement of an object (4) a certain distance which object is displaceable between a forward position (9) and a rearward position (10), comprising a unit (14) displaceable between a first position (12) and a second position (13) for driving the object (4) a distance corresponding to the distance between the first and the second position by means of a friction joint (15) when the driving unit (14) is displaced from the first position to the second position, said friction joint being designed to enable displacement of the driving unit (14) and the object (4) relative to each another under the influence of a certain lowest force, and a member (16) which is arranged to act on the driving unit (14) in a direction towards the second position (13) by means of a spring force, **characterized in that** the device comprises a component (21) for interconnecting the driving unit (14) and the object (4) and that the interconnecting component (21) has a surface (22) which is designed to form the friction joint (15) in cooperation with a surface (23) of the driving unit and that the interconnecting component and the object are interconnected so that the interconnecting component and the object are locked against displacement relative to each other when the object (4) is acted on in a direction towards the forward position (9) and the interconnecting component (21) is acted on in the opposite direction, for driving the object (4) to the rearward position (10) by means of the interconnecting component (21) when the driving unit (14) is displaced to the second position (13) during influence of the spring member and for driving the driving unit (14) to the first position (12) by means of the interconnecting component (21) when the object (4) is displaced to the forward position (9).

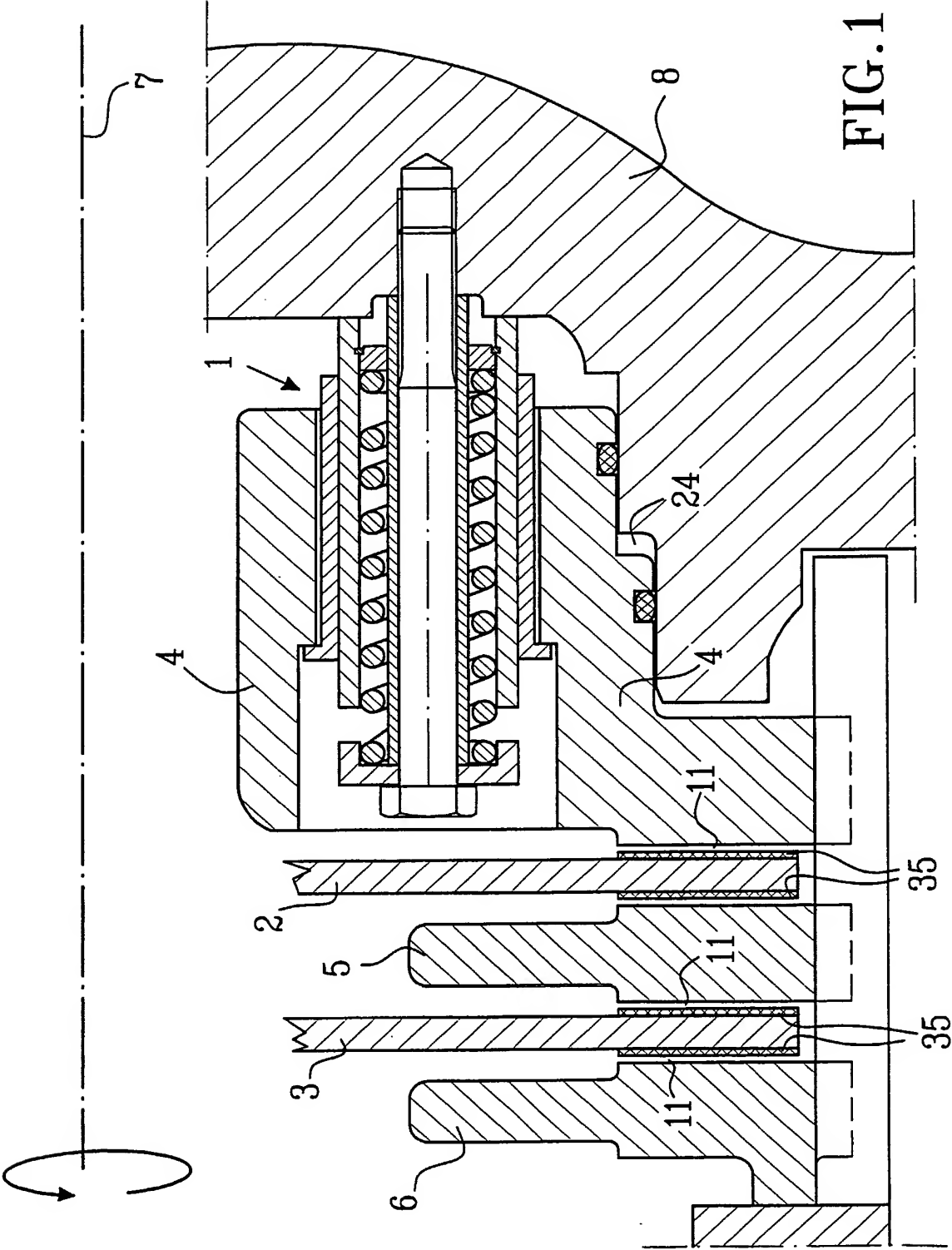
30 2. A device according to claim 1, **characterized in that** at least one of the interconnecting component (21) and the object (4) is provided with a shoulder (25, 26) for the interconnection of the interconnecting component (21) and the object (4).

35 3. A device according to claim 2, **characterized in that** the interconnecting component (21) is provided with said shoulder (25) and the object (4) is provided with a corresponding shoulder (26), and that these shoulders (25, 26) are arranged to cooperate for interconnecting the interconnecting component (21) and the object (4).

40 4. A device according to any preceding claim, **characterized in that** the interconnecting component (21) and the object (4) are arranged relative to each other so that a play (27) having an extension in a direction which is substantially perpendicular to the displacement direction of the object between the forward and the rearward positions occurs between the interconnecting component (21) and the object (4).

- 5 5. A device according to any preceding claims, **characterized in that** the interconnecting component (21) is provided with at least one portion for taking up any occurring deformation of and/or force from the object to thereby avoid loading the contact surfaces (22, 23) of the friction joint (15).
- 10 6. A device according to any preceding claims, **characterized in that** it comprises a first stop (28) against which first stop the driving unit (14) abuts when being in the first position (12) and the object (4) is in the forward position (9).
- 15 7. A device according to any preceding claims, **characterized in that** it comprises a second stop (29) against which second stop the driving unit (14) abuts when being in the second position (13) and the object (4) is in the rearward position (10).
- 20 8. A device according to claims 6 and 7, **characterized in that** the driving unit (14) is located substantially between the first stop (28) and the second stop (29) and that the extension of the driving unit between a surface (30) of the driving unit which is intended to abut against the first stop and a surface (31) of the driving unit which is intended to abut against the second stop is adapted to the distance between the first stop and the second stop so that, when the driving unit is in the second position (13), the distance between the first stop (28) and the surface (30) of the driving unit (14) which is intended to abut against the first stop (28) corresponds to the distance that the object (4) is displaced from the forward position (9) when the object is displaced from the forward position (9) to the rearward position (10).
- 25 9. A device according to any preceding claim, **characterized in that** the driving unit (14) is a first sleeve.
- 30 10. A device according to claim 9, **characterized in that** it comprises a pin (18) around which said first sleeve (14) is arranged substantially concentrically and along which the sleeve is displaceable.
- 35 11. A device according to any preceding claim, **characterized in that** the interconnecting component (21) is a second sleeve.
- 40 12. A device according to claims 9 and 11, **characterized in that** said second sleeve (21) is arranged concentrically and externally relative to the first sleeve (14).
13. A device according to claims 6 and 10, **characterized in that** the pin (18) in a first free end (32) thereof is provided with said first stop (28).

- 5 14. A device according to claims 7 and 10, **characterized in that** the pin (18) in an anchored second end (33) thereof is provided with said second stop (29).
15. A device according to claim 10, **characterized in that** the pin (18) is attached to a component (8) in which the object (4) is slidably journaled.
- 10 16. A device according to any preceding claim, **characterized in that** the device is designed for the object (4) which constitutes a piston arranged to cooperate with one or more brake discs (2, 3) for braking thereof when being in the forward position (9).
- 15 17. An arrangement to brake a vehicle, comprising a device according to any of claims 1-16.
18. A vehicle comprising a device according to any of claims 1-16.
- 20 19. Use of a device according to any of claims 1-16 for automatic adjustment of a brake piston (4) and a brake disc (2) cooperating with the brake piston at a certain distance (11) relative to each other.



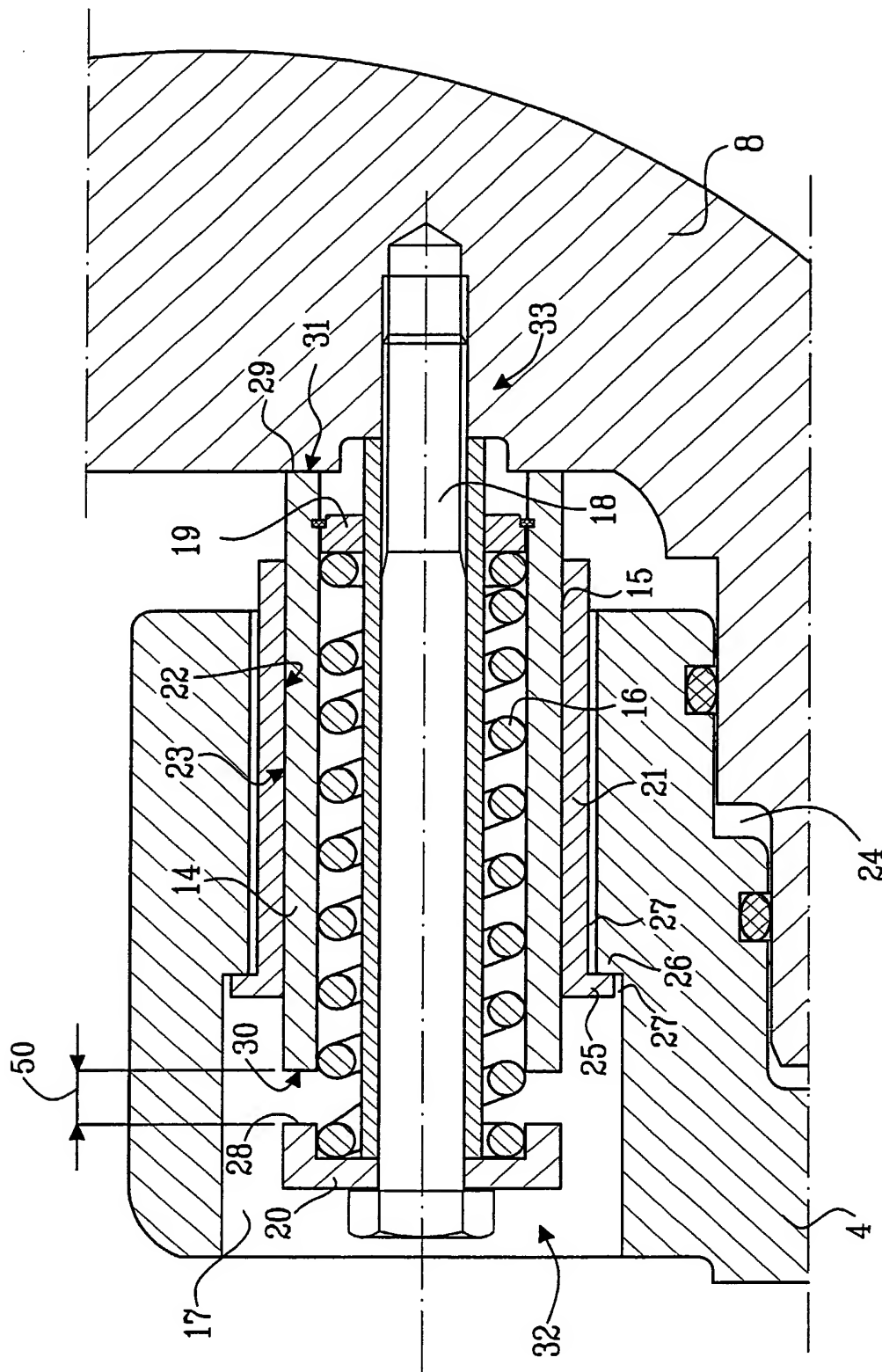


FIG. 2

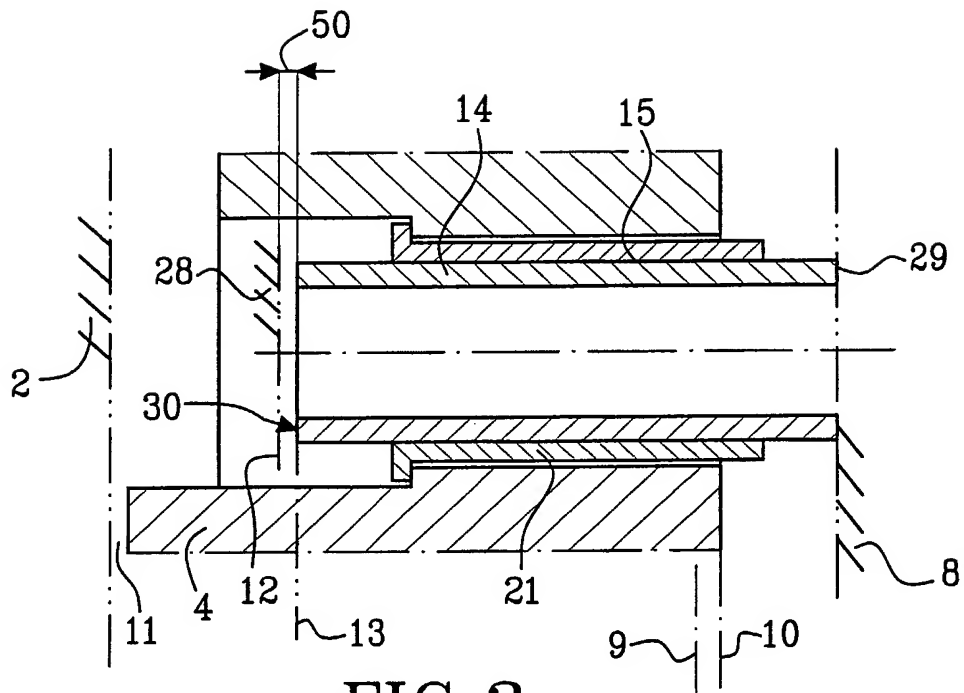


FIG.3

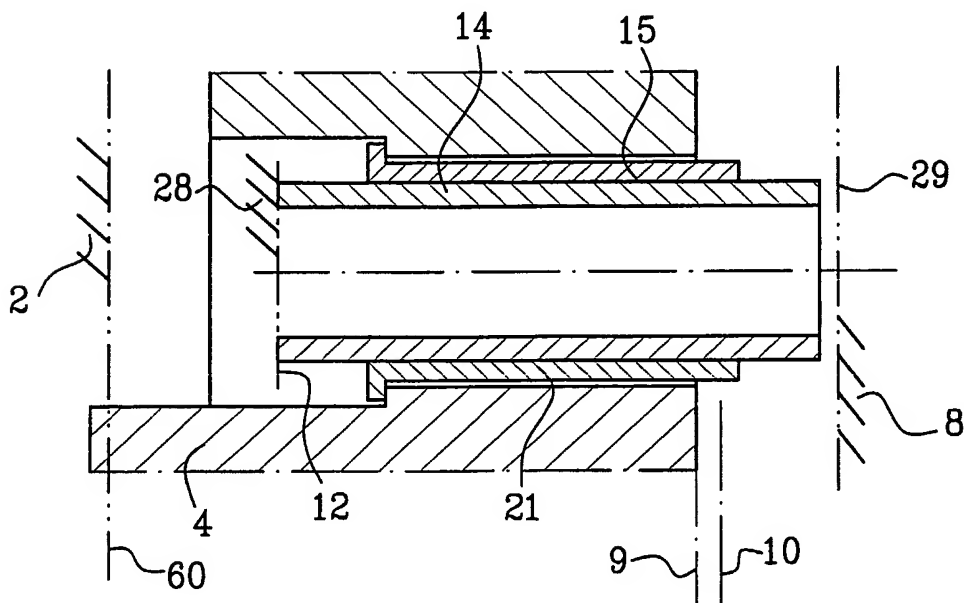


FIG.4

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 03/00498

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F16D 65/54, F16D 55/40, F16D 13/75

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3762522 A (KIRSCHLING), 2 October 1973 (02.10.73), column 3, line 26 - line 68, figures 5-8, abstract --	1-3,9-12, 15-19
A	US 4010828 A (DITLINGER), 8 March 1977 (08.03.77), figure 2, abstract --	16,17,19
A	US 3957146 A (LE BLANC), 18 May 1976 (18.05.76), figure 1, abstract --	16,17,19
A	GB 2099939 A (THE BENDIX CORPORATION), 15 December 1982 (15.12.82), figure 1, abstract --	16,17,19

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

23 June 2003

Date of mailing of the international search report

24 -06- 2003

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 03/00498

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 10012358 A1 (GUSTAV MAGENWIRTH GMBH), 20 Sept 2001 (20.09.01), figure 3, abstract  --	16,17,19
A	US 6016892 A (BERWANGER), 25 January 2000 (25.01.00), figures 2a-c, abstract  --	16,17,19
A	EP 0105977 A1 (DEERE & COMPANY), 25 April 1984 (25.04.84), figures 6,7, abstract  --	16,17,19
A	US 4993532 A (WEISS ET AL), 19 February 1991 (19.02.91), figures 1,2A,2B, abstract  --	16,17,19
A	US 4640400 A (NAKANE ET AL), 3 February 1987 (03.02.87), figure 3, abstract  -- -----	16,17,19

**INTERNATIONAL SEARCH REPORT**International application No.  
**PCT/SE03/00498****Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☒ Claims Nos.: **1-15, 18**  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:  
**see next sheet**
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

Present claims 1-15 and 18 relate to an extremely large number of possible devices. Support within the meaning of Article 6 PCT and disclosure within the meaning of Article 5 PCT is to be found, however, for only a very small proportion of the devices claimed. In the present case, the claims are so undefined that a meaningful search over the whole of the claimed scope is impossible. For example is the term "object (4)" such a wide expression that it can not be searched.

Consequently, the search has been carried out for those parts of the claims which appear to be supported and disclosed, namely those parts related to a device intended to be used in a vehicle brake or the use of such a device when automatically adjusting a brake piston and brake disc. An additional search has also been carried out for the usage of such a device in a clutch arrangement. Support for this can be found in claims 16, 17 and 19 and in the description page 10 line 20.

The partial novelty search done has revealed US 3 762 522 A as representing particular relevant prior art useful for the searching and examination of the application. The document discloses the technical features stated in claims 1-3, 9-12 and 15-19.

In view of this document the device mentioned in claim 1-3, 9-12 and 15-19 lacks novelty and inventive step. However, if only one or more of the features of claims 4-8, 13 or 14 are included in claim 1, the claims will still relate to too many possible devices - devices which are not covered by this search. Consequently, the claims must be more specified to follow the regulations of Article 5 PCT. For example, it can be defined in claim 1 that the device relates to brakes or clutch arrangements.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

02/06/03

International application No.

PCT/SE 03/00498

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
US	3762522	A	02/10/73	US	3858700	A	07/01/75
US	4010828	A	08/03/77	FR	2328887	A,B	20/05/77
				GB	1514863	A	21/06/78
US	3957146	A	18/05/76	CA	1045053	A	26/12/78
GB	2099939	A	15/12/82	CA	1174611	A	18/09/84
				DE	3219897	A	13/01/83
				JP	58000454	A	05/01/83
DE	10012358	A1	20/09/01	EP	1264119	A	11/12/02
				WO	0169102	A	20/09/01
US	6016892	A	25/01/00	EP	0975888	A	02/02/00
				WO	9906729	A	11/02/99
EP	0105977	A1	25/04/84	SE	0105977	T3	
				AT	24035	T	15/12/86
				AU	562215	B	04/06/87
				AU	1937183	A	05/04/84
				BR	8305256	A	02/05/84
				CA	1206893	A	01/07/86
				DE	105977	T	25/10/84
				DE	3274572	D	00/00/00
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				KR	136793	B	15/05/98
US	4640400	A	03/02/87	JP	1872473	C	26/09/94
				JP	5083767	B	29/11/93
				JP	60188628	A	26/09/85